This print-out should have 26 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

This is our first try, so work with me on this!

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001 10.0 points

A solution has $[H^+] = 3.9 \times 10^{-4}$ M. Find the pH of this solution.

1. 3.41 **correct**

2. −3.40

3. 10.59

4. neutral

5. 4.41

Explanation:

$[H^+] = 3.9 \times 10^{-4}$ M.

$$\text{pH} = -\log[H^+] = -\log(3.9 \times 10^{-4}) = 3.41$$

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002 10.0 points

What is the pH of a solution that contains 11.7 g of NaCl for every 200 mL of solution?

1. 10^{-1}

2. 1.0

3. 1.0×10^{-7}

4. 7.0 **correct**

Explanation:

m_{NaCl} =11.7 g $V_{soln} = 200$ mL

NaCl completely dissociates in water to give Na^+ and Cl^-, neither of which hydrolyzes and so in aqueous NaCl the H_3O^+ and OH^- ions result from autoionization of water.

$$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$$
$$[H_3O^+] = [OH^-] = 1 \times 10^{-7}$$

and $\text{pH} = -\log[H_3O^+] = 7.0$

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003 10.0 points

An unknown substance is added to a solution and the pH decreases. The substance is best described as

1. an acid. **correct**

2. a solvent.

3. a base.

4. a salt.

Explanation:

Acids have the smaller pH values of the reason of the scale which goes from 0 to 14.

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004 10.0 points

All Bronsted-Lowry acids must contain

1. hydrogen. **correct**

2. the hydroxide ion or the hydroxyl (OH) group.

3. an unshared pair of electrons.

Explanation:

The proton donated by a Bronsted-Lowry acid is a hydrogen which was covalently bonded in the molecule but which departed, leaving behind the bonding pair of electrons.

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005 10.0 points

According to the Lewis theory a base

1. is a proton donor.

2. is a proton acceptor.

3. makes available a share in a pair of electrons. **correct**

4. accepts a share in a pair of electrons.

Explanation:

A Lewis acid is any species that can accept and share an electron pair.

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006 10.0 points

Calculate the H^+ concentration of a solution

prepared by dissolving 180 g HCl in 3.0 L of water.

1. 0.835 M

2. 1.67 M **correct**

3. 6.68 M

4. 3.33 M

Explanation:
$m_{HCl} = 180$ g $\quad V_{HCl} = 3.0$ L

HCl is a strong acid which completely dissociates in a aqueous solution, producing H^+ ions:

$$HCl \longrightarrow H^+ + Cl^-$$

$$[H^+] = [HCl] = 180 \text{ g HCl} \times \frac{1 \text{ mol HCl}}{36.5 \text{ g HCl}} \times \frac{1}{3.0 \text{ L soln}} = 1.64 \text{ M}$$

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007 10.0 points

Of the following, a solution with which pH would have the greatest concentration of hydronium ions?

1. 8 **correct**

2. 9

3. 12

4. 10

Explanation:
$pH = -\log[H_3O]$, so lower values of pH have higher concentrations of H_3O^+.

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008 10.0 points

What is the pH of a 0.010 M solution of H_2SO_4? Consider that both H atoms are completely ionized.

1. 3.9

2. 2.0

3. 1.7 **correct**

4. 2.3

5. 0.020

Explanation:
$[H_2SO_4] = 0.010$ M

	$2\,H_2O + H_2SO_4 \rightarrow$	$2\,H_3O^+$	$+\ SO_4^{2-}$
ini, M	0.01	0	0
Δ, M	-0.01	$+2(0.01)$	$+0.01$
fin, M	0	0.02	0.01

$$pH = -\log 0.02 = 1.7$$

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009 10.0 points

Which one of the following is a correct definition of an acid that is not dependent upon the solvent?

1. Acids produce hydronium ions.

2. Acids produce hydroxide ions.

3. Acids are proton acceptors.

4. Acids are proton donors. **correct**

Explanation:
The Bronsted-Lowry theory defines acids as proton donors. H_3O^+ is the product when the proton is accepted by water.

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010 10.0 points

A solution having a pH of 1.4 would be described as

1. distinctly acidic. **correct**

2. slightly basic.

3. neutral.

4. slightly acidic.

5. distinctly basic.

Explanation:
On the pH scale, solutions with pH from 0 to 2 are strongly acidic.

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011 10.0 points

Which pH represents a solution with 1000 times higher $[OH^-]$ than a solution with pH of 5?

1. pH = 0.005

2. pH = 4

3. pH = 8 **correct**

4. pH = 6

5. pH = 2

6. pH = 1

7. pH = 3

8. pH = 7

9. pH = 5000

Explanation:
pH = 5

$$\text{pOH} = 14 - \text{pH} = 14 - 5 = 9$$
$$[OH^-] = 10^{-\text{pOH}} = 10^{-9}\text{ M}$$

$$[OH^-]_x = 1000\,[OH^-] = (10^3)(10^{-9}\text{ M}) = 10^{-6}\text{ M}$$

$$\text{pOH}_x = -\log(\text{OH}_x) = 6$$
$$\text{pH}_x = 14 - \text{pOH}_x = 14 - 6 = 8$$

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012 10.0 points

A solution in which the pH is 12.5 would be described as

1. slightly basic.

2. slightly acidic.

3. neutral.

4. distinctly basic. **correct**

5. distinctly acidic.

Explanation:

On the pH scale, solutions with pH from 12 to 14 are strongly basic.

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013 10.0 points

Calculate the $[H^+]$ in a solution which shows a pH of 11.70.

1. 5.0×10^{-3} M

2. None of these

3. 2.3 M

4. 11.7 M

5. 2.0×10^{-12} M **correct**

Explanation:

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014 10.0 points

Acidity and pH are related as follows:

1. pH = 7 is very basic.

2. pH = 1 is neutral.

3. pH = 1 is very basic.

4. pH = 7 is very acidic.

5. pH = 1 is very acidic. **correct**

Explanation:

On the pH scale (0 to 14) the lowest values indicate extreme exists acidity, the highest values indicate extreme basicity and 7 indicate a neutral solution.

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015 10.0 points

Choose the pair of concentrations that cannot be in a given aqueous solution at 25°C.

1. $[H_3O^+] = 10^{-14}$ M : $[OH^-] = 1$ M

2. Any of these could exist. **correct**

3. $[H_3O^+] = 10^{-7}$ M : $[OH^-] = 10^{-7}$ M

4. $[H_3O^+] = 10^{-3}$ M : $[OH^-] = 10^{-11}$ M

5. $[H_3O^+] = 10$ M : $[OH^-] = 10^{-15}$ M

Explanation:

All of these concentrations are possible. Recall that pH can exist beyond the 1-14 range, but at 25°C, pH + pOH = 14 always applies.

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016 10.0 points

If you add 0.001 moles of HCl to a liter of water, the pH of the solution will be

1. 3.0 **correct**

2. 4.0

3. 1.0

4. 5.0

5. 2.0

Explanation:

$n_{\text{HCl}} = 0.001$ mol $V_{\text{H}_2\text{O}} = 1$ L

HCl is a strong acid which completely dissociates in aqueous solutions.

$$[H_3O^+] = \text{HCl} = \frac{0.001 \text{ mol HCl}}{1 \text{ L solns}} = 1 \times 10^{-3} \text{ M}$$

$$\text{pH} = -\log[H_3O^+] = 3$$

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017 10.0 points

In the reaction

$CO_3^{2-} + H_2O \rightarrow HCO_3^- + OH^-$

what is the role of the bicarbonate ion?

1. acid

2. base

3. conjugate base

4. conjugate acid **correct**

Explanation:

The bicarbonate ion is HCO_3^-. It is the conjugate acid of CO_3^{2-}. The base CO_3^{2-} gains an H^+ to form its conjugate acid HCO_3^-.

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018 10.0 points

Identify the Lewis Base in the reaction

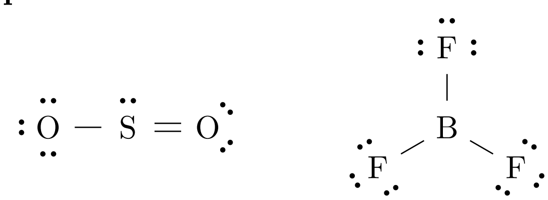
$$SO_2 + BF_3 \rightarrow O_2SBF_3 \,.$$

1. O_2SBF_3

2. SO_2 **correct**

3. BF_3

Explanation:



SO_2 has a lone pair of electrons which it shares in a coordinate covalent bond with the electron-poor BF_3.

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019 10.0 points

A solution has an $[OH^-]$ of 10^{-12} M. Find its pH.

1. 14

2. 2 **correct**

3. 7

4. 12

Explanation:

$[OH^-] = 10^{-12}$

$$\text{pOH} = -\log[OH^-] = 12$$

$$\text{pH} = 14 - \text{pH} = 2$$

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020 10.0 points

What is the hydroxide ion concentration in a solution made by adding 117 grams of NaCl to enough water to make 4.0 L of solution?

1. 1.0×10^{-7} M **correct**

2. 0.5×10^{-7} M

3. 0.3 M

4. 0.5 M

5. 2.0 M

Explanation:

$m_{NaCl} = 117$ g $\qquad V = 4.0$ L

NaCl completely dissociates in aqueous solution to give Na^+ ions and Cl^- ions, neither of which hydrolyzes. The H^+ ions and OH^- ions present are from autoionization of water.

$$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$$

$[H^+] = [OH^-]$, so

$[H^+] = \sqrt{(1.0 \times 10^{-14})}$ M $= 1.0 \times 10^{-7}$ M

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021 10.0 points

A solution whose pH is 3 is how many times as acidic as a solution whose pH is 6?

1. 2

2. 100

3. 1000 **correct**

4. 10

5. 6

Explanation:

$pH_1 = 3 \qquad pH_2 = 6$

$[H_3O^+] = 10^{-pH}$ is a measure of acidity.

$$\frac{[H_3O^+]_1}{[H_3O^+]_2} = \frac{10^{-pH_1}}{10^{-pH_2}} = \frac{10^{-3}}{10^{-6}} = 10^3$$

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022 10.0 points

Consider the acid-base reaction

$$H_2PO_4^- + H_2O \rightarrow \text{products}$$

If $H_2PO_4^-$ acts as the base, what would be one of the products of the reaction?

1. OH^- **correct**

2. HPO_4^-

3. H_3O^+

Explanation:

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023 10.0 points

What mass of limestone ($CaCO_3$) must react to raise the pH of a small lake (3.54×10^8 L) from 5.0 to 6.5?

1. 1.71 kg

2. 171 kg **correct**

3. 9.7×10^{-6} g

4. 3428 g

5. 5.60×10^8 g

Explanation:

$pH_{ini} = 5.0 \qquad pH_{fin} = 6.5$

$V = 3.54 \times 10^8$ L $\qquad MW_{CaCO_3} = 100.09$ g

To find the change in molarity of H^+,

$$pH = -\log[H^+]$$
$$10^{pH} = [H^+], \quad \text{so}$$

$$[H^+]_i = 10^{-5.0} = 1 \times 10^{-5}\text{ M},$$
$$[H^+]_f = 10^{-6.5} = 3.16228 \times 10^{-7}\text{ M}, \quad \text{and}$$
$$\Delta[H^+] = 9.68377 \times 10^{-6}\text{ M}.$$

The amount of H^+ to be neutralized in the lake is

$$\begin{aligned} n &= M\,V \\ &= (9.68377 \times 10^{-6}\text{ mol/L})\,(3.54 \times 10^8\text{ L}) \\ &= 3428.06\text{ mol } H^+ \end{aligned}$$

The $CaCO_3$ neutralizes the H^+ by

$2\,H^+(aq) + CaCO_3(s) \rightarrow$
$\qquad Ca^{2+}(aq) + CO_2(g) + H_2O(\ell)$

There is a 1:2 ratio between $CaCO_3$ and H^+, so

$$m_{CaCO_3} = (3428.06 \text{ mol H}^+)\frac{1 \text{ mol CaCO}_3}{2 \text{ mol H}^+} \times \frac{100.09 \text{ g CaCO}_3}{1 \text{ mol CaCO}_3} = 1.71557 \times 10^5 \text{ g} = 171.557 \text{ kg}$$

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024 10.0 points

Choose the $[H^+]$ that corresponds to a pH of 6.49.

1. None of these

2. 3.23×10^{-7} M **correct**

3. 0.49×10^{6} M

4. 6.49×10^{1} M

5. 3.23×10^{-6} M

Explanation:
pH = 6.49

$[H^+] = 10^{-pH} = 10^{-6.49} = 3.236 \times 10^{-7}$ M

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025 10.0 points

A sample is prepared by dissolving KOH in water. The pH of this solution will be

1. lower than 7.

2. 7.

3. greater than 7. **correct**

Explanation:
KOH is a strong base and so the pH of its aqueous solution will be between 11 and 14.

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026 10.0 points

Which of the following is the conjugate acid of NH_3?

1. H_3O^+

2. NH_3

3. NH_4^+ **correct**

4. NH_2^-

Explanation:
NH_4^+ has one proton (H^+) more than NH_3.